Agency IT Overview

Agency IT Plan Contact Data

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Agency Technology Goals And Objectives

1 *GOAL* - The agency will maintain and enhance the current technology infrastructure to provide sufficient flexibility to meet the changing requirements associated with water resource management.

Objectives

- Maintain a replacement policy that is based upon a four year life-cycle. The four-year life-cycle is in line with the state guidelines and is consistent with the life-cycle of the technology. (Short/Medium/Long)
- Evolve and enhance the technology infrastructure to accommodate analytical scientific tools. (Short/Medium/Long)
- Maintain software currency as software revisions are made available (Short/Medium/Long)
- Enhance the software base with newer software technology as it becomes available. (Short/Medium/Long)

2 *GOAL* - The agency will develop training programs and procedures to provide better integration and use of information technology throughout the agency.

Objectives

- The agency will investigate and implement training procedures to insure that the technology infrastructure is effectively utilized. (Short/Medium/Long)

3 *GOAL* - The agency will enhance and evolve public access to the various types of information that is generated and maintained by the SWC.

Objectives
- Enhance the capabilities for public access to the data managed by the SWC, which includes the state's Well Inventory, Water Permits, Precipitation, Dams, Drains, Wetlands, and other miscellaneous data. This also include the development of better tools to accommodate methods for presenting this data in functional and useful formats (i.e. graphical display of temporal and 3D relationships within the data, etc.) (Short/Medium/Long)
- Enhance GIS technology and its integration with the Internet to provide a spatial perspective for the data resources managed by the SWC. (Short/Medium/Long)
- Explore and evaluate options to develop and expand database capabilities to include legal documentation for purposes of making this information available over the Internet. (Medium/Long)

4 *GOAL* - The agency will maintain and enhance the existing communications infrastructure to accommodate the increasing communications requirements for data and voice.

Objectives
- The agency will migrate the existing network from 100 megabit to 1 gigabit to accommodate increased bandwidth requirements. (Short)
- The agency will improve teleconferencing and video conferencing technologies to improve public access to Water Commission meetings and to reduce transportation costs associated with employee travel.

5 *GOAL* - To support and enhance the operational capability of the North Dakota Cloud Modification Project and research projects in the Cooperative Research program by acquiring and providing meteorological data, products, analysis, forecasting, nowcasting, and aircraft tracking.

Objectives
- Acquire and manipulate forms of meteorological data to provide meteorological products, forecasting, and nowcasting support to the North Dakota Cloud Modification Project (NDCMP) and any associated project within the Cooperative Research program. (Short/Medium/Long)
- Enhance the operational software base through updates and user-group interaction. (Short/Medium/Long)
- Continue to acquire meteorological data and provide field support with meteorological products, forecasting, and nowcasting of summer convective weather for operational and research projects. (Short/Medium/Long)
- Evolve with the changing state of technology in weather analysis and forecasting to enhance the products produced. (Short/Medium/Long)

6 *GOAL* - GIS will continue to play an important role in the development of sound management tools for water resource management. With the development of the state GIS hub and internal agency GIS resources, the SWC has started the development of a much more structured approach to the management and utilization of the spatial data and resources.

This necessitates the need to maintain and enhance the GIS infrastructure that the agency is currently constructing.

Objectives

- The agency will need to enhance and develop additional training resources for the use of GIS within the agency. A comprehensive training program will need to include both internal training using existing personnel and external training provided by certified training centers. (Short/Medium/Long)

- The agency will need to continue to enhance and evolve the integration of the spatial data services with the non-spatial systems that are currently in place. This has already been extended to address management capabilities, but will require additional enhancements in the areas of analytical tool base development for water resource analysis. (Short/Medium/Long)

- The agency will continue to grow and evolve spatial data resources through the digital conversion of significant air photo resources. This includes large holdings of Color Infrared photography and standard aerial photography.

- It will also be important to develop integration between the internal spatial management and the Internet to provide an effective means of presenting agency data within its proper spatial context. (Short/Medium/Long)

- The agency will continue to grow and evolve Internet based map services to provide access to not only the water resource data and data analysis tools to make this data more useful to the general public.

1. If applicable, describe the reason for any extraordinary increase or decrease in your infrastructure costs.
The increases in the SWC IT infrastructure budget are attributed to the following. The 4% salary increase constitues an increase of $17,894. ITD rate increases for network access and the porposed upgrade of the SWC network represent an increase of $68,147 for network services. ITD rate increase for telephone services presents an increase of $18,175. The addition of new blackberry devices for staff use adds an increase of $11,760. All of these combined provide for an increase of $115,976.

2. Total number of desktop computers: 101
Number of desktops for which you are requesting replacement funding: 50
Average replacement cost/desktop: 1,600

3. Total number of laptop computers: 17
Number of laptops for which you are requesting replacement funding: 5
Average replacement cost/laptop: 2,600

What state planning region are these desktop/laptop computers located?

Region 1	0	**2**	0	**3**	0	**4**	0	**5**	2	**6**	0	**7**	116	**8**	0

4. What percentage of these pcs are running the following operating systems:
(total should be equal to 100%)

Windows 98	0 **%**
Windows NT	0 **%**
Windows 2000	44 **%**
Windows XP	20 **%**
Other	36 **%**

5. What additional expenditures are being paid out of non-appropriated funds? 0
Please explain:

Agency Technology Activities
SWC IT Value Matrix

The State Water Commission (SWC) is responsible for the management and regulation of the water resources in the State of North Dakota. The mission of the agency and the State Engineer . .

. . . is to improve the quality of life and strengthen the economy of North Dakota by managing the water resources of the state for the benefit of its people . . .

The SWC utilizes information technology to support almost all facets of the business operations surrounding water resource management. Agency IT requirements are generally driven by the scientific applications used for water resource analysis. Advanced data analysis, research, data modeling, and engineering applications are routinely combined with

customized applications that are developed internally. Because of the wide range and diversity of applications used, the IT infrastructure must be open and extensible. An open framework supports a wide range of diverse applications, which makes it possible to easily scale and evolve the IT infrastructure to accommodate changes in current initiatives as well as any new initiatives.

In 1999, the SWC developed a needs assessment that addressed the scientific and engineering requirements for the agency as it moved forward. This needs assessment ultimately led to the strategic planning that laid the foundation for the current infrastructure. Within this assessment, the framework that was defined identified significant investments that would be required in the IT infrastructure, if the agency was to continue to meet it's water resource management obligation in the years to come. During the 01-03 and the 03-05 bienna, the SWC's IT infrastructure was completely re-engineered to provide a framework for the agency to develop the necessary tool base to meet the challenges that the agency would face over the next two decades. During the 05-07 biennium, additional components of the infrastructure framework were completed and significant work was completed to integrate and extend much of the IT infrastructure to address many of the key scientific functions required for water resource management. There are four key areas that will require ongoing attention, which include data management, GIS services, computational capabilities, and storage management. In addition to these key management areas, the SWC will also need to complete the upgrade enhancements to push our LAN to gigabit speeds.

LAN Infrastructure

At the end of the 2003-2005 biennium, the Water Commission contracted with ITD to re-wire the State Office Building to accommodate a network infrastructure capable of delivering gigabit speed to the desktop. This project was completed in anticipation of the network performance requirements to accommodate large file and data transfers that routinely occur within a scientific GIS operation. During the 2005-2007 biennium, the SWC continued to operate the network at speeds of 100 mb because ITD's per port costs for gigabit were still rather restrictive and because the agency needs for gigabit performance had not fully materialized. For the 2007-2009 biennium, it will be necessary to upgrade the network to accommodate gigabit performance to address growing bottlenecks as more and more image data resources are made available to SWC users.

Data Management

Data collection is an integral part of many of the SWC's on-going water resource management operations. Water resource data pertaining to water levels, water chemistry, and well information is collected for purposes of monitoring impacts to North Dakota's ground and surface water resources. This includes on-site data collection by agency field staff and private contractors, and continuous data collected using electronic methods. The SWC also collects real-time data for radar and flight operations for the North Dakota's weather modification and hail suppression program. GPS technology is used to collect real-time data within many of the flight operations. GPS technology is also used to generate the necessary survey base for construction projects and many other site-specific projects requiring spatial reference information.

The SWC maintains cooperative reporting programs for purposes of collecting water use information, private domestic drilling information, and observed precipitation information. In addition, the SWC is involved with a variety of data collection efforts to obtain site specific information relevant to water permits, dams, drains, wetlands, and other construction projects that pertain to water diversion or retention. The SWC also routinely collects and processes aerial photography for many areas where there has been significant irrigation development for purposes of monitoring irrigation, evapotranspiration, and other parameters relevant to water resource management.

The SWC has implemented a wide range of technology solutions within various aspects of the data collection programs. The SWC has implemented electronic monitoring tools in many of the data collection programs in an effort to provide more accurate data and to reduce overall cost associated with data collection. This includes the use of electronic transducers for purposes of monitoring water levels in real-time. In addition to electronic collection efforts, technology has also been implemented in the form of hand-held devices and laptops to facilitate field entry and eliminate re-entry into back office systems.

The SWC has developed a fairly extensive data management infrastructure to accommodate the volume of data that is collected. This data management infrastructure has been developed to address the unique needs associated with management of water resource data, which include both spatial and temporal components. The SWC has extended the data management to include tools and resources that aid in data collection and data analysis processes.

The data management infrastructure currently maintained by the SWC is based upon a distributed client-server architecture. Given the diverse types of data collected combined with the broad range of analysis requirements, the SWC has expended considerable effort to establish an open and extensible management infrastructure that will support the very different types of data and the associated collection, management, and analysis efforts. This infrastructure currently supports industry connectivity standards, including ODBC, JDBC, XML, Web Services, Oracle OCI, and many others. At this point, the SWC can push or pull data to almost any commercial software that uses standard communications protocols, and all of the data collected by the SWC is available for public access over the web.

Currently, the SWC maintains a data management system with more than 4 million records. This includes water levels, well information, chemistry, lithology, water permits, water use, dams, drains, diversion structures, wetland information, precipitation, and survey notes. In addition to these data resources, the agency also maintains significant spatial data resources in the form of vector and raster data sets maintained within the state GIS hub and within SWC infrastructure.

GIS Services

As part of the needs assessment that was developed in 1999, the SWC identified the role that GIS would play in the development of future water management resources. This assessment clearly identified the size and scope of the infrastructure required to provide the necessary GIS resources. Given the size of the user base that would be served at the SWC, it was not cost effective for the SWC to develop core components of this infrastructure internally. Therefore, recommendations were made for ITD to provide these core components of the infrastructure so that they could be extended to a larger user base. The SWC worked closely with ITD to develop the strategic and funding requirements necessary to provide the state with a shared GIS infrastructure capable of delivering base GIS services for the state government users. The SWC has also been instrumental in the data development and implementation of the state GIS hub.

While the GIS hub provides core services required for the SWC's GIS initiative, the majority of tools and management functions required for water resource management will need to be designed and built internally in order for these services to provide value for water resource management. While the agency obtained funding to deploy some initial resources using ESRI's base infrastructure, both the ESRI cost model and limitations with ESRI's support model for open industry standards made it difficult to build the necessary infrastructure around the ESRI model. As a result, selected open source alternatives were evaluated and deployed through the 2005-2007 biennium. The open source solutions that were selected were capable of being deployed on existing hardware infrastructure and supported the same industry connectivity standards as the existing SWC data management infrastructure. This provides significant opportunities to develop integrated data management solutions and more comprehensive data analysis solutions that better meet the flexible requirements associated with managing North Dakota's water resources.

The majority of the GIS infrastructure required to provide the necessary services for the SWC is currently in place and is integrated with the current management programs. Moving into the 2007-2009 biennium, the SWC will be building many of the analysis tools that will provide the foundation for future water resource management programs.

Computational Services

Increasing demands for more comprehensive analysis of surface, subsurface, and atmospheric systems is driving the agency to develop more sophisticated modeling capabilities. Currently, the agency uses a variety of modeling tools available from the US Geological Survey, US Bureau of Reclamation, the US Army Corps of Engineers, and other sources. These tools are used to provide insight into the environmental and geologic characteristics of these systems so that the agency can develop better operational and management methods for the respective systems.

While many of these tools have been available for some time, the application of these tools has evolved in recent years and utilization of these tools now demand far more resources to achieve useful results. In most cases, the model requirements exceed the computational capabilities available on a single desktop or server. The current server base that has been deployed provides tools capable of addressing the computational requirements for the next generation of ground water, soil profile, surface water, and atmospheric models. This technology can also be extended beyond the server core to include the higher end desktop workstations. This feature allows the agency to leverage not only the server core, but also all of the higher end desktops to extend the computational resources as needs grow and evolve. Because of the nature and extensibility of the core IT infrastructure, the SWC has developed and will continue to grow and evolve super-computer class computational resources for little or no cost.

Storage Management

The SWC is responsible for many paper data resources for which there are no duplicates. This includes the General Land Office (GLO) survey plats, Survey Notes, Water Permits, Drillers Logs, and many other resources. Historically, these resources existed in paper form and there are no backup copies available, and many were deteriorating with age. In order to preserve and maintain these data resources, the SWC digitized many of these resources to provide digital copies to be used in-house and to provide a means of storing copies off-site for disaster recovery purposes. In addition, most of these resources have also been made readily available to the general public as well.

Over the past twenty years, the SWC has collected aerial imagery and other remotely sensed data of many areas where irrigation development is growing and in areas where there has been flooding or flooding concerns. This imagery is an invaluable resource for determining and documenting hydrologic conditions relevant to specific events. Historically, this imagery was provided in paper form. However, with improvements in GIS and image technology, this data can now be used within GIS to provide better utilization of the data. The SWC has nearly completed the digitization of the image resources that are available within the agency, and now efforts will begin to focus on the conversion of these resources into spatially enabled products so that they can easily be used within a GIS framework.

In addition to digitizing many of the historic paper records and the imagery, the SWC has also increased the volume of data that has traditionally been collected for water resource monitoring through the use of continuous recorders and other means. This has resulted in significant increases in the data that is collected and maintained by the SWC.

In order to accommodate increasing storage requirements, the storage infrastructure for the SWC was completely re-engineered during the 2001-2003 biennium. There were several factors that contributed to the architecture that was implemented which included a requirement to provide a more functional and systematic means for managing storage for the agency. It was necessary to provide storage services that were independent of the server resources so that available storage could easily be increased as additional data became available. By separating storage and servers, the storage services can also be used more efficiently across the entire server base. The storage infrastructure that was implemented has accommodated the storage requirements for the SWC and has provided a means of controlling storage costs to levels that do not significantly exceed standard desktop storage costs.

Return on Investment

It is very difficult to look at the SWC's IT and separate it from the context of the agency business model to determine the effectiveness of that investment. If you instead look at the agency business model, there are many factors that require consideration in order to make this type of assessment, and many of these are rather subjective. For purposes of the strategic plan, the effectiveness of the IT investment will be developed by comparing the costs of the existing system at the SWC to the costs that would be incurred if the same services were provided by ITD. This includes File and Print services, storage, application services, application development, and web services. ITD's current service model provides an effective means of measuring the efficiency of the SWC's IT infrastructure as it represents current state standards and would be representative of costs that would be incurred under the current standard model presented for state government. The estimates used here are based upon ITD's current rate structure.

File and Print Services

File Services are currently maintained at the SWC on an internal server that also provides many other services, which include network monitoring, directory services, and others. This server is also used to manage the computational services that are being supported by the server core. The SWC currently does not use any print services. Costs to implement File Services from ITD would present a server cost of $14,400 for the biennium and user fees of $6,630 for a total of $21,030. This service would be dedicated to File and Print services and would not address any of the other services currently maintained on the agency internal server.

Computation Services / Distributed (Grid) Computing

ITD currently does not provide any form of computational services, nor is there any plans to provide this in the future. Therefore, it is not possible to use the ITD model to properly evaluate this service. It is also difficult to determine the costs associated with performing this function with an alternative infrastructure as the SWC has currently implemented this functionality on top of the existing file and print servers and the existing Macintosh end-user desktops with no additional licensing costs. It would be fairly easy to state that there is no additional cost associated with the deployment of this service using the existing SWC IT infrastructure. Also, any other technology platform would be limited to the server component of the existing SWC xGrid cluster. Therefore, there is no real alternative that would provide any return given the server infrastructure that would be required to achieve the same computational capabilities that are currently provided by the SWC xGrid cluster. As a result, it is highly unlikely that the SWC would be able to deploy any form of Grid computing capability under any other infrastructure architecture.

Application Services / Web Services

The SWC currently maintains ten separate application services that provide the application base and data management services for the agency. ITD's current rate structure is tiered. However, based upon discussions with ITD, the SWC could be looking at a monthly rate of approximately $400 per application. This translates to $96,000 for the biennium. In addition to the application services, the SWC also maintains a web service application that is fully integrated with current data management systems. This application would also require some re-design, but just the monthly web service hosting fees would have a biennial cost of $9,600. This brings the total application and web service hosting fees to $105,600 per biennium.

Storage Services

Storage demands for the SWC are measured in terabytes, not gigabytes or megabytes. The SWC is involved with various state and federal partners where large data collection

efforts are underway or have been completed. Many of these collection efforts have yielded aerial photography, LIDAR, satellite imagery, and other types of data products that have large storage requirements. Most of the imagery and data products are currently stored in digital format. It has not been practical or feasible to put these data products on-line until just recently as a direct result of the cost-effective data storage infrastructure deployed by the SWC.

The SWC currently maintains storage services with approximately 12 terabytes of available storage. All of this storage would be equivalent to ITD's current Silver storage service, which ITD provides at $5/GB/month. Using this rate structure, total biennial storage costs for 12 terabytes would be $1,440,000. In addition to the storage requirements, the SWC will also require tape archival of components of this data. Using ITD's current rate structure for tape archive, the biennial cost for tape archive would be approximately $165,000. When combined with the storage costs, this brings the total biennial storage cost to $1,605,000.

Application Development

The SWC began using 4th Dimension (4D) in 1990 for purposes of data manipulation and data management because the solutions available from ITD were not capable of meeting agency requirements. The 4D environment extends beyond data management to provide integrated application services. This environment has grown over the past 16 years, and 4D is now the primary data management and application base used by the agency.

The agency has re-evaluated the 4D infrastructure in responses to changes at ITD. While previous ITD (CDP at the time) mainframe solutions did not provide the necessary flexibility, more recent ITD solutions using Oracle could provide the necessary flexibility to meet agency data management requirements. However, maintenance costs associated with data management built around the Oracle infrastructure was found to be more than 10 times that of the current infrastructure, and this did not include the costs of re-designing and re-building the existing 4D infrastructure. Therefore, the agency elected to maintain the 4D infrastructure.

In order to utilize ITD's infrastructure, the current application and data management infrastructure at the SWC would need to be re-designed and rebuilt to run within ITD's supported infrastructure using Oracle for data management and Java for application services. Without a detailed cost estimate, projecting the design costs for the SWC's existing systems is somewhat subjective. However, this exercise does serve to provide a framework for consideration. The estimates presented here were derived by projecting the number of hours anticipated for this type of project. Once the hours were identified, ITD's rate structure for programming and project management were used to develop the cost projections.

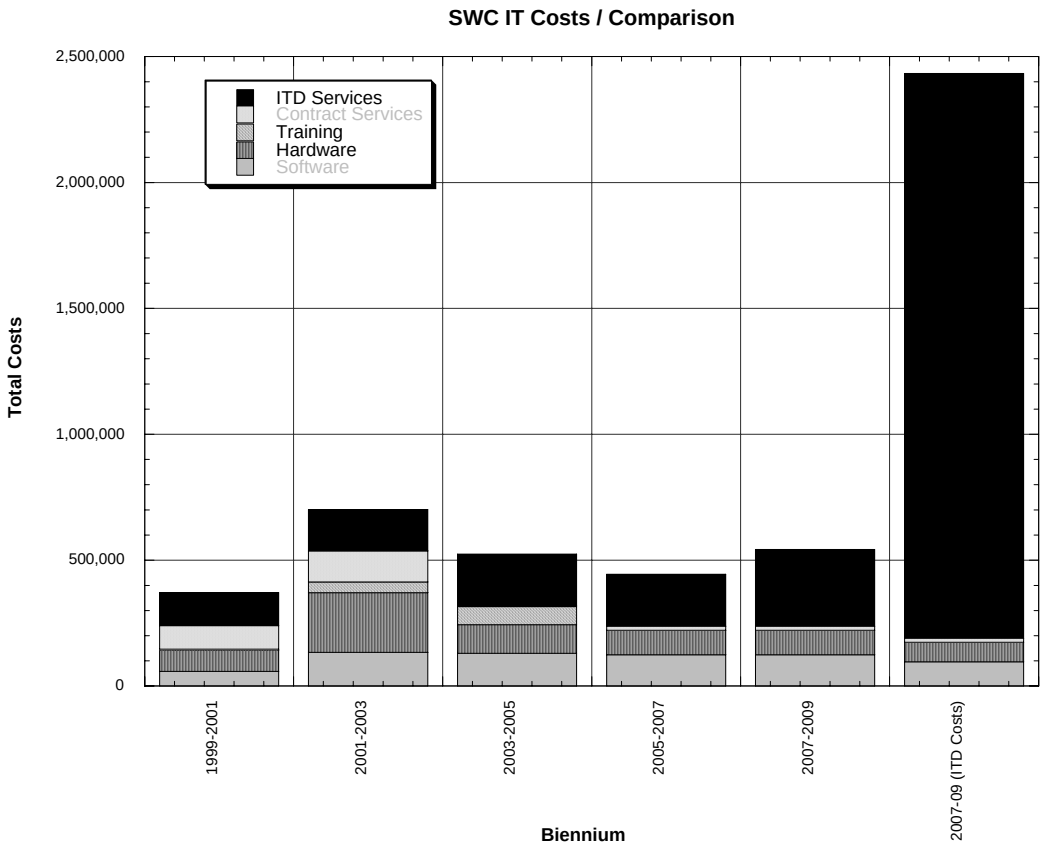
The SWC currently maintains ten application services for general data management that would require re-tooling. In addition, the SWC web services application would also require a significant amount of work to provide the same integration with the new data management infrastructure. In order to rebuild all of the existing services, the SWC has estimated an initial programming overhead of 22,000 hours at a rate of $58/hour. In addition, estimates for project management were placed at 2,150 hours at a rate of $80/hour. The estimates derived for project management were somewhat low because in this case the existing systems should provide a reasonable design, which should reduce the time spent in project management. Using these estimates, the SWC has identified a total cost for rebuilding the current application infrastructure to be $1,448,000. These estimates do not include agency staff time for training relevant to the new system, nor does it include down time and lost time. These estimates also do not include costs and overhead associated with maintaining parallel development efforts that will be required if the agency were to move forward with the existing 4D system during the two to three year period in which the new systems are under construction.

Summary

There will be other unforeseen costs beyond those presented that will impact the overall costs associated with an infrastructure model supported by ITD. However, the costs presented here provide sufficient detail to compare the agency's current infrastructure costs with those provided under ITD's current model. If the standard model supported by ITD has been identified as the most cost effective model for state government, then it should provide an effective metric to evaluate the costs and benefits associated with the infrastructure deployed by the SWC.

The IT budget for the SWC is presented below for the last four biennia along with the projected budget for the 2007-09 biennium. In addition, the last column includes the costs projected for the 2007-09 biennium if the agency infrastructure was provided by ITD using ITD's current rate structure. Only core IT services were included so that the price differences could be presented more clearly. For the costs projected for the 2007-09 under ITD's infrastructure, ITD Services includes the $304,241 that is currently projected for the agency budget as this is network and telephone fees that will still be required. Also, the hardware and software items were lowered for the ITD supported alternative to reflect the reductions in agency server infrastructure requirements. Application development costs presented above were not included in the comparison as these represent one-time costs and are not reflective of base infrastructure costs. However, these costs ($1,448,000) would be incurred in the event that the SWC were to elect to utilize the infrastructure provided by ITD.

Biennium	1999-01	2001-03	2003-05	2005-07	2007-09 (current)	2007-09 (ITD Model)
ITD Services	132,155	163,148	205,352	206,159	304241	2,242,030
Contract Services	93,000	123,773	3,317	16,445	16,445	16,445
Training	4,000	42,500	7,500	0	0	0
Hardware	84,000	237,333	114,169	97,356	97,356	78,000
Software	59,000	133,730	129,944	124,500	124,500	96,000
Total	372,155	700,484	460,282	444,460	542,542	2,432,475



While there would be savings in both the hardware and software line items, these are more than offset by the increases in the ITD Service costs. The overall total presents an increase in base infrastructure costs that would approach $2 million dollars per biennium. This is only offset by $48,000 dollars in savings in the hardware and software line items.

The FTE line item was not included in this analysis because of the differences in accounting for FTE applied to IT over this time period. Currently, the agency has 2 FTE's allocated to IT. Even if both positions could be eliminated, the ITD supported infrastructure would still represent base increases of more than $1.7 million dollars per biennium. In reality, it is not reasonable that either IT position could be eliminated because agency IT operations would still require internal management and administration even with ITD supported infrastructure.

In addition to the areas identified in this analysis where there are known costs, there are many other facets to the current infrastructure that were not identified or addressed. In

particular, the computational services that the agency has developed within the existing infrastructure would not be available within the existing infrastructure provided by ITD, and if they were to be developed, there would be additional costs associated with these services.

In the end, return on investment can only be determined by applying subjective criteria to evaluate the performance of the SWC in fulfilling the water resource management mission for which it has been tasked. When the costs and functionality of the current IT model developed by the SWC is compared with implementation under the model provided by ITD, the SWC has performed extremely well and has implemented technology that is appropriate and cost effective to meet the agency business requirements. This has been defined and well documented over the years within the strategic planning process. If the agency is to accomplish the same tasks and provide the same functionality to agency staff and the same level of services to the general public using the consolidated infrastructure, it will cost the agency an additional $3.3 million for the first biennium with on-going costs increases of more than $1.9 million per biennium. Additional information and a more detailed breakdown of this information are available if needed.

		CURRENT APPROPRIATION	BUDGET REQUEST	OPTIONAL ADJUSTMENTS	REQUEST PLUS OPTIONALS	SUBSEQUENT BIENNIUM
IT1008	BENEFITS	$0	$0	$0	$0	$0
IT5110	SALARIES - PERMANENT	$0	$203,160	$0	$203,160	$0
IT5160	FRINGE BENEFITS	$0	$61,538	$0	$61,538	$0
IT5310	IT SOFTWARE AND SUPPLIES	$118,500	$124,500	$0	$124,500	$124,500
IT5510	IT EQUIPMENT UNDER $5000	$97,356	$97,356	$0	$97,356	$97,356
IT6010	IT DATA PROCESSING	$129,917	$129,917	$68,147	$198,064	$198,064
IT6020	IT COMMUNICATIONS	$75,742	$103,377	$0	$103,377	$106,177
IT6030	IT CONTRACT SERVICES & REPAIRS	$16,445	$16,445	$0	$16,445	$16,445
IT6930	IT EQUIPMENT OVER $5000	$6,000	$30,000	$0	$30,000	$30,000
	Total Budget:	**$443,960**	**$766,293**	**$68,147**	**$834,440**	**$572,542**
001	STATE GENERAL FUND	$0	$0	$68,147	$68,147	$0
267	WATER DEVELOPMENT TRUST FUND 267	$443,960	$766,293	$0	$766,293	$572,542
	Total Funding:	**$443,960**	**$766,293**	**$68,147**	**$834,440**	**$572,542**